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Characteristics of Production Factors and Production of Zero Tillage System Rice Farming

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Abstract: Zero tillage system is able to prepare the land for plants to grow and produce well by paying attention to the ecological balance of the environment, especially water and soil. The purpose of this study was to determine the characteristics of production factors and production characteristics of rice paddy farming with no-tillage system. This research used descriptive method, conducted in Taram village, Harau sub-district. Sample determination using snowball sampling method, with a total sample of 50 farmers. Data collection by interview using questionnaires for primary data and documentation method for secondary data. Data analysis used qualitative descriptive analysis with a triangulation approach. The results showed the characteristics of production factors include: paddy field area 0.25 - 2.0 ha, seed requirement 8 - 60 kg/acre, compost fertiliser 0.25 - 2 tonnes/acre, Urea fertiliser 25 - 200 kg, NPK Phonska fertiliser 25 - 200 kg, herbicide 1 - 3 litres, insecticide 1 - 2 litres, labour consists of labour within the family and labour outside the family, including: Labour and female labour, and capital consists of cash, hoes, and knapsack sprayers. The amount of farm labour can be reduced by up to 145%, especially in land preparation activities, because there is no tillage and only spraying of residual rice stalks and weeds. Rice production characteristics: Total production of 800 - 6,200 Kg/acre, with an average of 2,262.80 Kg. The selling price of rice production was IDR 7,500/kg - IDR 7,800/kg, with an average of IDR 7,710/Kg.

Keywords: Characteristic; Zero tillage: Rice; Production Factor

Introduction

Agricultural development in Indonesia has a very important role in the nation's economy. At the beginning of the New Order government, agricultural development policies influenced agricultural policies in Indonesia and led to the dependence of farmers to use chemical fertilisers. In Indonesia, green revolution technology began in the sixties, and since then food insecurity has gradually been overcome. Indonesia's achievements in meeting its food needs are marked by its success from a rice-importing country to a self-sufficient country (Sutanto, 2002; Mukhlis et al., 2023).

The development of food crop agriculture continues to be improved towards the achievement of regional food self-sufficiency, in order to increase the income of farmers and their families, expand employment opportunities and to meet regional needs through food crop agriculture. The government has adopted various main policies, namely intensification, extensification, diversification and rehabilitation in a harmonious and equitable manner to achieve resilient agriculture (Mukhlis et al., 2015).

Integrated farming system (IFS) as a concept of farming system that combines two or more farms (Channabasavanna et al., 2009; Jayanthi et al., 2009; Ugwumba et al., 2010; Massinai, 2012; Walia & Kaur, 2013; Jaishankar et al., 2014) where there are input-output linkages between commodities and biological recycling processes (Prajitno, 2009; Changkid, 2013; Massinai, 2012; Thorat et al., 2015), which use low external inputs (Devendra, 2011; Nurcholis & Supangkat, 2011; Hilimire, 2011) and utilise resources efficiently (Bosede, 2010; Balemi, 2012 and Soputan,

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2012), and apply various techniques so as to increase production, productivity and income of farmers and sustainably (Gupta et al., 2012; (Manjunatha et al., 2014; Thorat et al., 2015).

Rice is one of the commodities that has bright prospects for increasing farmers' income. This can provide its own motivation for farmers to further develop and increase production in the hope that at harvest time the business will get high sales results to meet its needs. But sometimes the reality speaks differently, when harvest time arrives the results are abundant but the price suddenly plummets, and even worse if the predicted production results are far off the amount of production produced, minimal production, low and uncertain prices make rice farmers sometimes feel disappointed and even discouraged to continue developing their agricultural business. This is because every activity of cultivating paddy fields must incur costs for production activities, starting from the procurement of seeds, fertilisers, processing, pesticides and other unexpected costs. Integrated rice and cattle farming must consider many production factors, namely: paddy fields, cattle sheds, rice seeds, seeds/feed, organic fertiliser, inorganic fertiliser, animal feed, pesticides, medicines and vitamins, labour, and capital. So far, the cultivation of rice plants carried out in Nagari Taram is carried out conventionally using a perfect tillage system, so it requires considerable costs to cultivate rice fields (Mukhlis et al, 2022).

According to (Rachman et al., 2004), zero tillage system (ZTS) is a planting method that does not require land preparation, except for opening a small hole to place the seeds. Reinforced by Wahyudin et al (2018), the TOT system is part of conservation tillage (OTK) combined with herbicides at the right dose to control early weeds. The application of the zero tillage system with herbicides aims to prepare the land so that plants can grow and produce well by paying attention to the ecological balance of the environment, especially water and soil. Based on the background of the research, it has not been discussed about the characteristics of production and production factors of zero tillage rice farming.

Based on the above background, there has been no discussion of the characteristics of zero tillage system rice farming. Therefore, there is a need for research that will explore the characteristics characteristics of production factors and production of zero tillage system rice farming in Taram Village, Harau District. The problem in this study is how the description of production and production factors of zero tillage system rice farming. The objectives of this research are to determine the characteristics of production factors and production of zero tillage system rice farming.

The ZTS is part of conservation tillage (OTK) combined with herbicides at the right dose to control early weeds. The application of the zero tillage system with herbicides aims to prepare the land so that plants can grow and produce well by paying attention to the ecological balance of the environment, especially water and soil (Wahyudin et al., 2018). The perfect zero tillage system is usually carried out on land that has never been used, so it is necessary to do tillage ± 3 times so that the soil becomes fertile. Meanwhile, zero tillage system is more suitable for land that has already been cultivated, so it is sufficient to clear weeds by spraying with herbicides because this can save costs (Ardiansyah et al., 2015). Maize farmers in Indonesia recognise two tillage systems: complete tillage and zero tillage system (ZTS) (Fitria & Sabrina, 2017).

According to the Dinas Ketahanan Pangan dan Pertanian Kabupaten Ngawi (2022), one of the methods that has been applied to Maize farming is zero tillage system which is a method of planting without land preparation such as turning and loosening. This method only requires a hole to bury the seed in the ground. In Indonesia, the tool used to poke holes in the soil where seeds are planted is tugal. The zero tillage system method can only be applied to loose soil. Because it is not good if applied to soil that is too hard, which will inhibit plant growth. Emphasised by Putra et al., (2023), Cultivating with a zero tillage system is cultivation where the soil preparation is not processed first. The activities of hoeing, ploughing, harrowing that are generally commonly done, in this technology are not carried out. The soil preparation process is replaced by spraying herbicides.

The application of no-till maize technology on rainfed rice fields can increase the cropping index from 100 and 200 to 200 and 300 (Amir & Arif, 2018). The application of zero tillage system in producing hybrid maize seeds in rainfed rice fields can increase the cropping index from IP 100 to IP 200, accelerate planting time and can utilise residual soil water to reduce tillage costs (Syamsia et al., 2019). In South Bengkulu Regency, many maize farmers use the zero tillage system, because maize cultivation is a staple business for farmers so it is often carried out, besides that the soil conditions are also loose, so only weed eradication is needed (Fauzi et al., 2022).

Method

Location and Research Time

This research uses descriptive qualitative research methods, this research uses descriptive research methods. According to Wirartha, (2006), descriptive research is research that describes and summarises various conditions, situations or various variables. Then,

analyse and present facts systematically so that they are easier to understand and conclude. The research was conducted in Lima Puluh Kota Regency, where Harau District, Harau Village was selected. The selection of the research area was carried out by purposive method or deliberately Sugiono, (2013). Selected Nagari Taram, Payakumbuh District on the basis of considerations: (1) The selected village is an area where a lot of wet rice farming with no-tillage system in Payakumbuh Subdistrict; (2) The selected Nagari has never been held the same research. This research was conducted for a duration of 4 months (april until july 2024).

Sampling Method

The sampling method used is the snowball sampling method. This sampling method can be used if population data does not exist, making it impossible to make a sampling frame. With this method, the researcher first looks for respondents who match the predetermined criteria, then the respondent will invite his other friends to be used as respondents, and so on until the sample size is representative enough to fulfil the analysis. Therefore, the sample size for this research cannot be determined at the beginning of the research (Rianse & Abdi, 2013; Lyons & Doueck, 2010).

The snowball sampling method can be used when researchers have difficulty finding or identifying the population and the number cannot be determined accurately (Nurdiani, 2014). The snowball sampling method is a survey research method used if the sample is obtained through a rotation process from one respondent to another (Neuman, 2014).

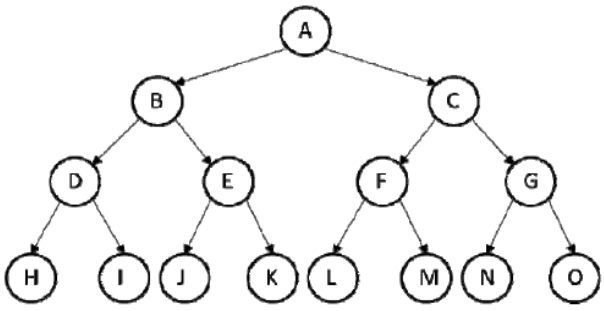

Figure 1. Snowball sampling technique chart

Data Collection Method

The types of data collected in this research include both primary and secondary data. a) Primary data is obtained from respondent farmers or sample farmers through the interview method based on a list of questions/questionnaires that have been prepared in advance; b) Secondary data obtained from various agencies that have to do with this research, in addition to information from various parties.

Data Analysis Method

To determine the description of the production of paddy rice farming with no-tillage system, descriptive analysis was conducted. The steps in data analysis are: a) Reduction; From the data/information that has been collected, sort out which information is appropriate and not in accordance with the research problem, focusing on simplifying, abstracting, and transporting rough data that emerges from written notes in the field; b) Presentation; After the information is selected according to the research needs, the results are presented in the form of tables or explanatory descriptions; c) Conclusion; Conclusion is the process of finding the meaning of data that aims to understand the interpretation in its context with the overall problem. Data analysis used 5 W (who, what, where, when, why) + 1 H (how).

Result and Discussion

Characteristic of Production Factors of Rice Farming with Zero Tillage System

Rice Land

Land area is the area of paddy fields owned by farmers that are used to grow rice. Land is one of the production factors that support the business being carried out. Land area can affect the amount of production. Broadly speaking, farmers have a paddy field area of 0.25 - 2.0 ha with an average land area of 0.73 ha. Then, most farmers have a land area of 1.0 ha (32%), and only a small number of farmers have a land area of 1.25 ha (2%). The condition of this land area is similar to the results of research by Suryati et al (2020), which concluded that the size of paddy fields owned by rice farmers in Musi Rawas Regency, South Sumatra Province ranged from <0.25 - 0.5 hectares.

Based on data and data processing results from BPS Lima Puluh Kota Regency (2010-2021) and the Office of Food Crops Horticulture and Plantations (2022-2024), the planting area of rice plants in Harau District has fluctuated. This fact can be clearly seen that the planting area of rice plants decreased several times significantly in 2016 and 2019, where the decline reached 12.30% and 5.83%. Then the planting area of rice plants increased significantly in 2014 and 2017, where the increase reached 5.83% and 22.13%. However, the average growth of the rice plantation area each year has increased by 1.97% per year.

The harvest area of rice plants in Harau Sub-district also experienced fluctuations. This fact can be clearly seen that the harvest area of rice plants decreased several times significantly in 2017 and 2020, where the decline reached 18.69% and 11.30%. Then the harvest area of rice plants increased significantly in 2015 and 2018, where the increase reached 11.08% and 65.66%. However, the

average growth of the harvested area of rice plants each year has increased by 2.76% per year.

The status of land ownership is divided into: a) self-owned land where the paddy field is purely owned by the farmer; b) land with a profit-sharing system where the land belongs to the investor where the results will be divided according to the agreement that has been set at the beginning; and c) land with a pawn system where the land has the status of the farmer's property which is valid as long as the land is still under the pawn agreement. However, when the pawn period expires, the land is returned to the owner. However, in general, the ownership status of paddy fields is self-owned land.

Rice Seeds

In general, TOT system rice farmers in Harau Sub-district use local seeds because they are cheap, easy to obtain, and have higher grain production compared to superior seeds.Rice seeds commonly used by rice farmers are CK, Sijunjung, Pandan Wangi seeds. The amount of rice seed needed by farmers depends on the seed variety used, namely:8 - 60 kg/acre, while the average requirement of rice seeds is 30-36 kg/hectare.

In general, farmers can get rice seeds easily by buying them at local agricultural kiosks. The prevailing seed price in the market is IDR 35,000 - IDR 42,000 per bushel or IDR 10,000 - IDR 12,000 per Kg (weight of 1 bushel = 3.5 Kg). Farmers pay directly and in cash. Farmers can easily get rice seeds at any time with the desired quantity and quality.

Fertilisers

The types of fertilisers used by farmers in integrated rice and cattle farming are: Organic fertiliser in the form of manure, compost; inorganic fertiliser in the form of Urea, and NPK Phonska. Cow feces compost fertiliser with the dose given 250 - 2000 Kg or equivalent to 0.25 - 2 tonnes, with an average dose of 762 Kg. Urea fertiliser with a dose given of 25 - 200 kg, with an average of 73.70 kg; NPK PHONSKA fertiliser with a dose given of 25 - 200 kg with an average of 73 kg. Based on the survey results, the prevailing fertiliser prices in the market are compost fertiliser at IDR 1200 - IDR 1,400/Kg; Urea fertiliser at IDR 2,700 - IDR 2,800/Kg; while NPK Phonska fertiliser at IDR 2,900 - IDR 3,000/Kg. The condition is confirmed by the results of research by Suryati Nila, (2019) which concluded that the size of paddy fields owned by rice farmers in Musi Rawas Regency, South Sumatra Province ranged from <0.25 - 0.5 hectares.

Fertilisation of rice plants with organic fertiliser is done by sowing the fertiliser around the rice plant. Cow feces compost fertiliser is given once when the rice plants are 7 days before planting (dbp). Inorganic fertilisers are applied twice, namely: 1) Urea and NPK Phonska fertilisers are given when the rice plants are 15-21 dbp with the amount of half dose for Urea and NPK Phonska; 2) Half dose of Urea and NPK Phonska fertiliser was given when the rice plants were 45 - 75 hst. between <0.25 - 0.5 hectares.

Fertilisation of paddy rice plants with organic fertiliser is done by sowing the fertiliser around the rice plant. Cow feces compost fertiliser is given once when the rice plants are 7 days before planting (dbp). Inorganic fertilisers are applied twice, namely: 1) Urea and NPK Phonska fertilisers are given when the rice plants are 15-21 hst with the amount of half dose for Urea and NPK Phonska; 2) Urea and NPK Phonska half dose fertilisers were given when the rice plants were 45 - 75 dbp.

Pesticides

Pesticides used by farmers in integrated rice and cattle farming are: herbicides and insecticides to control weeds and pests. The pesticides used consist of: Turmadan (Herbicide) and Jagoan (Insecticide). Herbicides were used to control residual straw stalks and weeds at a dose of 1 - 3 litres. Insecticides were used to control rice pests at a dose of 1 - 2 litres. Weed and pest control is carried out by spraying weeds and plants attacked by ants using a knapsack sprayer. The survey results show that the price of pesticides prevailing in the market is insecticide at Rp 50,000/bottle; Herbicide at Rp 75,000 - Rp 80,000/Litre.

Labour

The labour used in zero tillage system rice farming is machine labour (hand tractor) for tillage and human labour in the form of in-family labour and out-of-family labour. Human labour includes: male labour (TKP) and female labour (TKW). The labour needed by farmers is easily obtained whenever farmers need it, this is because the average surrounding community works more as farmers so that if farmers offer work in the cultivation of rice plants they want especially at that time they are not working.

Labour tasks in zero tillage system rice farming include: preparation of paddy fields consisting of: Land preparation with the zero tillage system or often referred to as the Zero Tilage System. Spraying the remaining rice stalks and weeds in the paddy field, cleaning the bunds, making the nursery, nursery, planting, plant maintenance, in the form of: weeding, fertilising, pest and disease control, harvesting and post-harvesting. Based on the results of the survey, it can be explained that land preparation in the zero tillage system can reduce the cost of tillage, where only the cost of buying pesticides and labour to spray the remaining stems of rice plants and weeds in the paddy fields is the highest at Rp 490,000, this is a cost reduction of 145%. This

condition is confirmed by the results of research by Mukhlis et al (2022) that the cost of land preparation for integrated rice-cow farming with a perfect tillage system is high, reaching Rp 1,200,000. This shows that paddy rice farming with the zero tillage system is more feasible and profitable because it can reduce land preparation costs. This is an advantage and added value of the zero tillage system farming.

Capital

In accordance with the results of the survey, the capital owned by wet-rice farms is cash either privately owned or borrowed, hoes, and knapsack sprayers. In general, capital owned by farmers in farming is used in terms of: to rent land, for the cost of purchasing crop production facilities (Saprotan), and to pay labour wages.

Characteristic of Production Overview of Rice Farming with Zero Tillage System

Rice production in Harau District over the last 15 years (2009-2023) has fluctuated. This fact can be clearly seen that rice production has decreased several times significantly in 2013, 2017 and 2020, where the decline reached 16.31%; 16.92%; and 7.37%. Then rice paddy production increased significantly in 2014 and 2018, where the increase reached 11.81% and 37.05%. However, the average growth of rice production each year has increased even though it only increased by 2.66% per year. Rice productivity also fluctuates. Rice productivity decreased several times significantly in 2013 and 2018, where the decrease reached 12.56% and 17.27%. Then rice productivity increased significantly in 2014 and 2023, where the increase reached 12.06% and 7.03%. However, the average growth of rice productivity has increased even though it has only increased by 0.70% per year (BPS Lima Puluh Kota District, 2010-2021 and Dinas Tanaman Pangan Hortikultura dan Perkebunan, 2022-2024).

The amount of rice production produced by TOT system rice farmers in the research area ranged from 800 - 6,200 Kg. However, the average amount of paddy production produced is 2,262.80 Kg. The selling price of rice production received by farmers ranged from IDR 7,500/kg - IDR 7,800/kg, the average price of rice received by farmers was IDR 7,710/Kg.

Conclusion

The characteristics of the production factors of Paddy Rice Farming with Zero Tillage System are: paddy field area of 0.25 - 2.0 ha with an average of 0.73 ha, seed requirement of 8 - 60 kg/acre with an average of 30-36 kg/acre, compost fertiliser is given 0.25 - 2 tonnes/acre, Urea fertiliser is given 25 - 200 kg, NPK Phonska fertiliser is given 25 - 200 kg, herbicide is given 1 - 3 litres, insecticide is given 1 - 2 litres, labour consists of labour within the family and labour outside the family, including: Male Labour and female labour and capital consists of cash (privately owned and borrowed), hoes, and knapsack sprayers.

The amount of labour for farming Rice with Zero Tillage System can be reduced by up to 145%, especially in land preparation activities, because without tillage, only spraying the remaining rice stalks and weeds is done.

The characteristics of rice production are: Total production of 800 - 6,200 Kg/acre, with an average of 2,262.80 Kg. The selling price of rice production received by farmers was IDR 7,500/kg - IDR 7,800/kg, with an average of IDR 7,710/Kg.

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Author Contributions

MK: Developing ideas, analyzing, writing, reviewing, responding to reviewers' comments; IIS, NS, SF, HR: analyzing data, overseeing data collection: IU, RFW, RH, LH, HI, SN, AM, NS, reviewing scripts, and writing.

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Conflicts of Interest

The authors declare no conflict of interest.

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